Ecological Applications of Landsat Data—USDA Forest Service Science and Operational Needs

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Landsat Science Team Meeting
12-13 December, Washington, DC

Alternate Title: Herding of High-Quality Collaborators towards a Common Set of Landsat Science Goals

Zhiqiang Yang, Justin Braaten, David Mildrexler, Kevin Briggs, Peder Nelson, Eric Pfaff [Oregon State University]

Sean Healey, Gretchen Moisen, Todd Schroeder, Andy Gray, Hans-Erik Andersen, Ken Brewer, Brain Schwind [USDA Forest Service]

Steve Stehman [Syracuse University of New York]

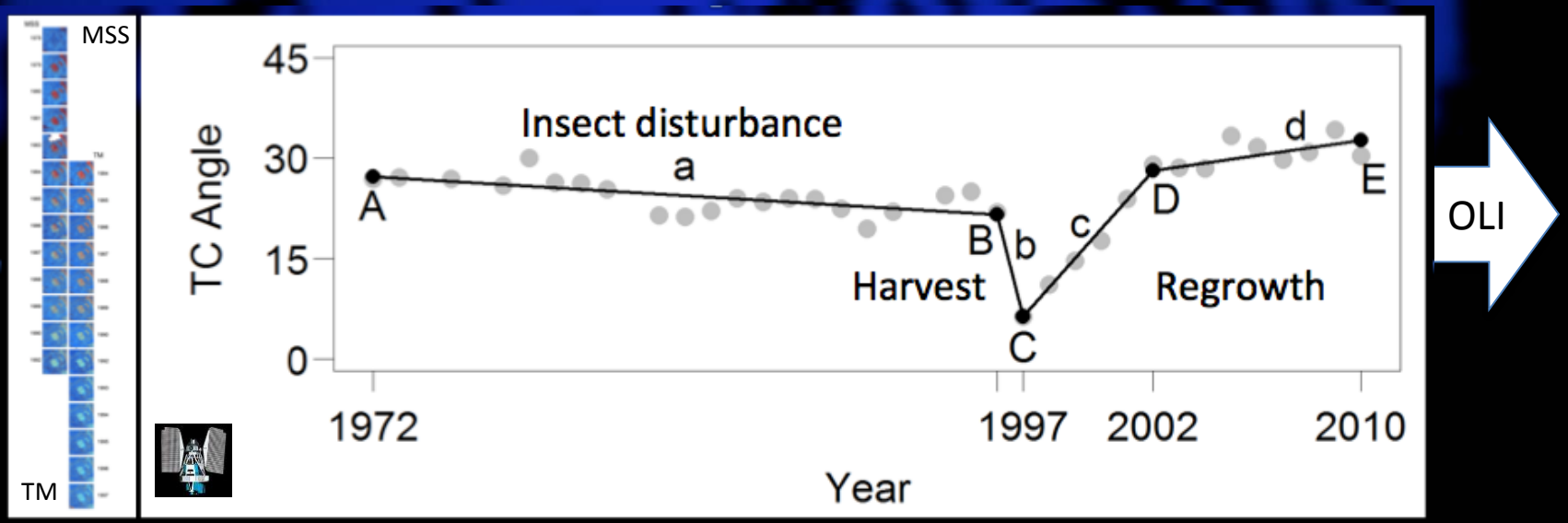
Dirk Pflugmacher [Humboldt University of Berlin, Germany]

Personal goal: Receive my *Certificate of Accomplishment* from Loveland and Irons at the end of my 5-year term

"Your five years experience herding cats is very impressive"

Objectives

1. **Temporal integration across all Landsat sensors for change detection applications**



- MSS & I have productive historic relationship, and recently worked them into annual-step time series analyses
- Next: automating process for large areas

Motivation

- Integration across *all* Landsat sensors is critical for US Forest Service and related agency science & applications
  - Long time periods of observation are important for understanding ecosystem resiliency to historic management and policy decisions ~ guide future decisions
  - Maximizing observational history aids understanding of climate effects on disturbance regimes, recovery processes, and migration of plant functional types

Objectives

2. **Further a nascent Landsat-based monitoring system for the US (LCMS) that builds upon a number of existing and recent past successes**
   - Statistical modeling framework that integrates map output from various time series algorithms, plot-level (high-quality) reference time series interpretations, and inventory and related data
   - Includes sampling & estimation framework to correct map-based change estimates for omission errors to produce adjusted estimates of annual change rates by change causal agent
   - Derives forest carbon consequences for observed changes

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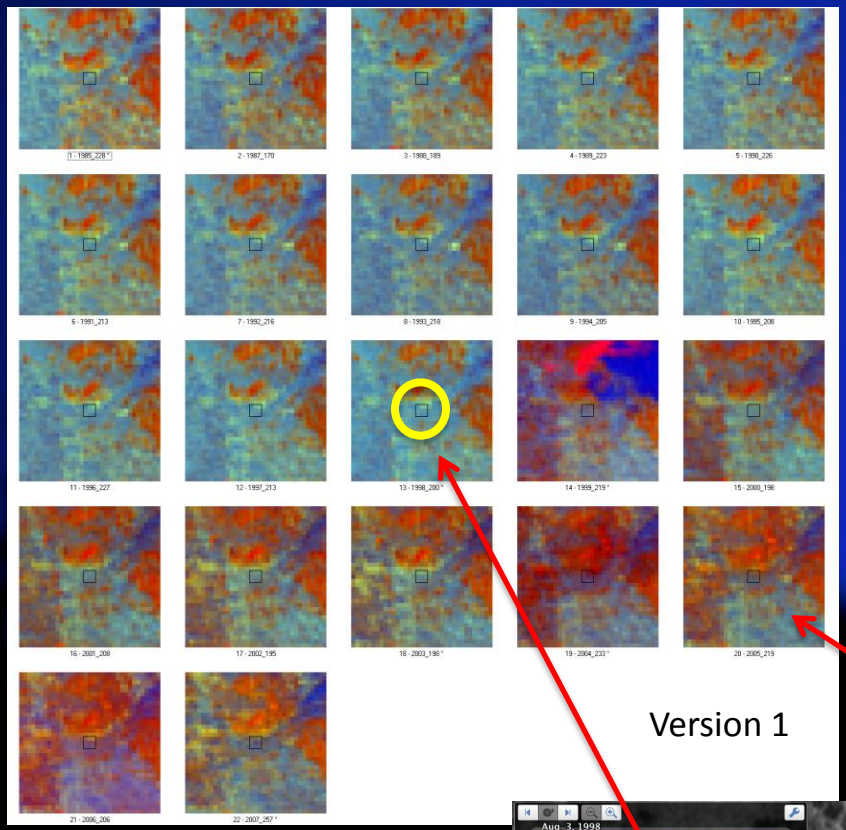
Motivation for these elements

- Change maps from satellite data are critical for quantification of forest dynamics in the context of management, policy, and international treaties
- Change maps derived from any automated algorithm using any satellite data are loaded with error
  - Results from 10 Landsat Paths/Rows (scenes)

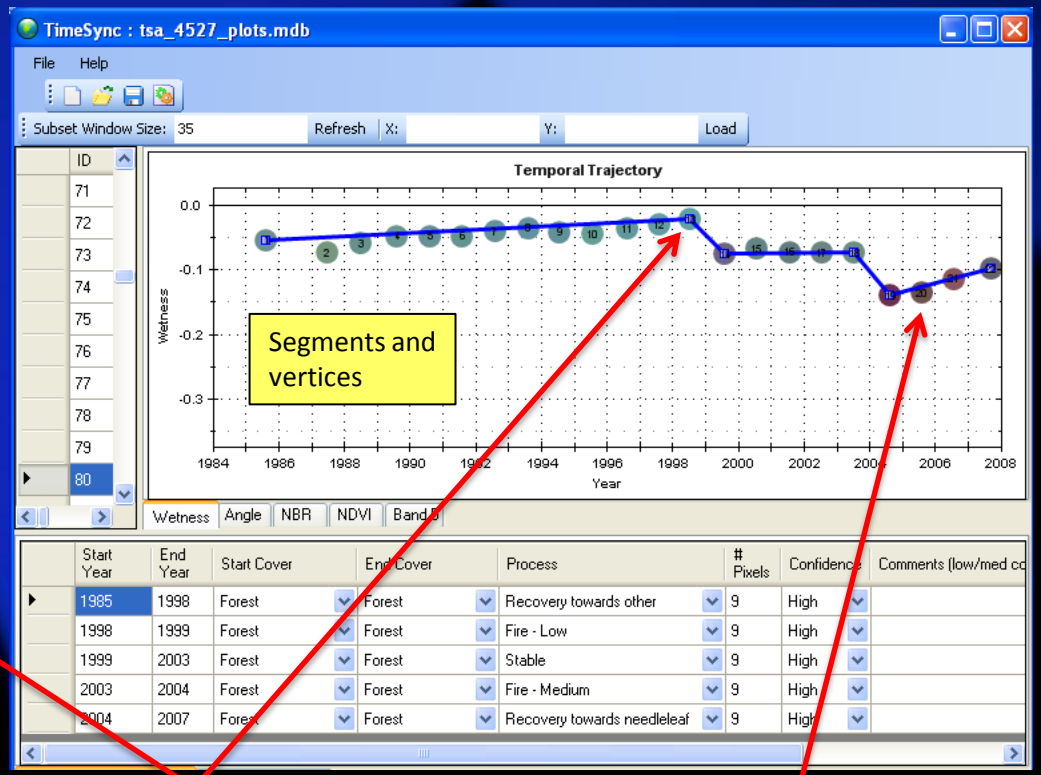
Counts	**Map**		
Reference	*Disturbed Forest*	*Undisturbed Forest*	***Omission***
Disturbed Forest	355	571	**0.617**
Undisturbed Forest	317	106087	**0.010**
Commission	**0.472**	**0.018**	

Motivation for these elements

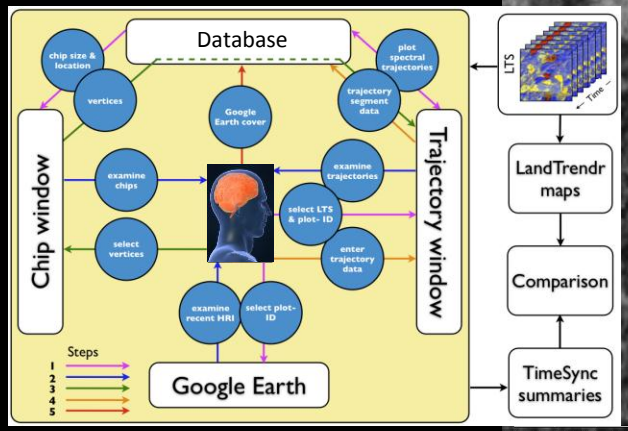
- Change maps from satellite data are critical for quantification of forest dynamics in the context of management, policy, and international treaties
- Change maps derived from any automated algorithm using any satellite data are loaded with error
- Consequence ~ mapped change area is only a first approximation in need of statistical calibration from plots
- Human interpretations of Landsat time series a largely untapped resource for this problem

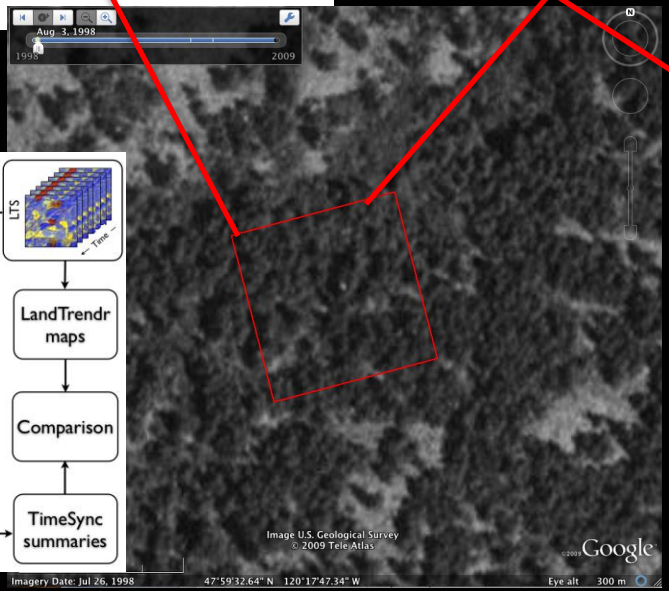


Version 1

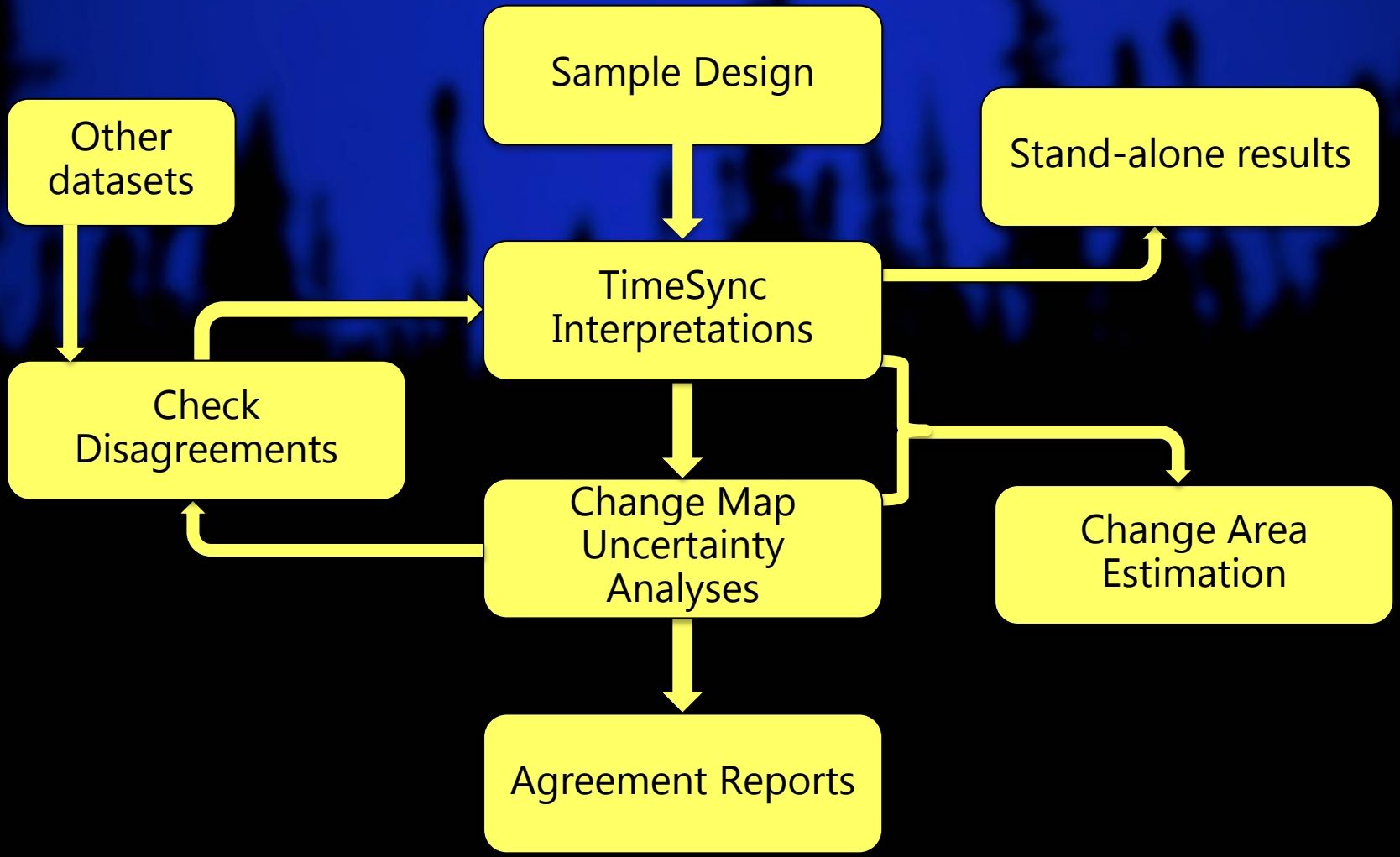


TimeSync example





TimeSync Workflow for Plot-based Observations



Results from Pilot Study of 10 Landsat Paths/Rows

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Error-adjusted Proportions	Commission	CI +/-	Omission	CI +/-	Overall Agreement	CI +/-
Disturbed Forest	0.472	0.038	**0.725**	0.029	0.976	0.002
Undisturbed Forest	0.018	0.001	**0.006**	0.001		

Error-adjusted Area	Map Area (ha) Across Years	Adjusted Map Area (ha) Across Years	CI +/-	Map Area (%) per Year	Adustedj Map Area (%) per Year	CI +/-
Disturbed Forest	7,000,364	13,427,279	833,794	1.29	2.47	0.49
Undisturbed Forest	536,007,420	529,580,505	833,794	98.71	97.53	0.49

Me and my team are excited to be a part of this very important program

Go Landsat!